

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
25 January 2001 (25.01.2001)

PCT

(10) International Publication Number
WO 01/06241 A1

(51) International Patent Classification⁷: **G01N 21/89, D21F 7/00, G01B 21/08**

(21) International Application Number: **PCT/FI00/00650**

(22) International Filing Date: **14 July 2000 (14.07.2000)**

(25) Filing Language: **Finnish**

(26) Publication Language: **English**

(30) Priority Data:
991612 15 July 1999 (15.07.1999) FI

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(81) Designated States (national): **AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.**

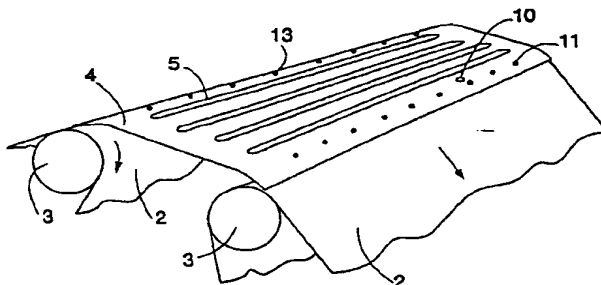
(84) Designated States (regional): **ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).**

Published:

- *With international search report.*
- *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **ARRANGEMENT FOR MEASURING PROPERTIES OF A MOVING PAPER WEB**



(57) Abstract: An arrangement for measuring properties of a moving paper web. The arrangement comprises measuring means for measuring paper properties, in connection with which a plane-like support surface (4) is arranged. The plane-like support surface (4) supports the paper web (1) and extends substantially over the whole width of the paper web (1) in the cross-direction relative to the direction of travel (A) of the paper web (1). An opening arrangement formed by at least one opening (5) is arranged on the support surface (4) for measuring properties of the paper web (1).

WO 01/06241 A1

ARRANGEMENT FOR MEASURING PROPERTIES OF A MOVING PAPER WEB

The invention relates to an arrangement for measuring properties of a moving paper web, which arrangement comprises measuring means for measuring properties of a paper web and a supporting member for supporting the paper web in connection with the measuring means.

Sections where the paper web is not supported by a wire, for example, are called open draws. Open draws cause flutter in the paper web, and particularly because of an increase in the speed of paper machines, open draws easily lead to web breaks, which cause considerable costs. Thus, the intention is to support the paper web in the paper machine as much as possible, for example with wires. However, during the manufacture, web properties are measured while the web is moving, which means that frequently, if required by the measuring method, for example, the measurements have to be performed without a wire that would support the web. Thus, open draws have to be used to perform the measurement.

US patent 4194840 discloses a measuring device comprising a convex lens arranged to be in contact with the paper web to be measured. US patent 3992100, in turn, discloses a measuring device comprising a spherical surface in contact with the paper web to be measured, which surface encircles the measuring window. In both of the above solutions, the means in contact with the paper web leave scratches and traces on the paper web. Further, although contacting the paper web, the measuring means are not able to support the paper web sufficiently.

WO publication 97/10383 discloses one solution for supporting the web during measurement. In this solution, sensing means measuring properties of a paper web are positioned in a carriage arranged to traverse back and forth in the cross-direction relative to the direction of travel of the paper web. Plane-like members, such as a flexible belt, are arranged in connection with the carriage to support the paper web. The belt is attached to both edges of the measuring head, a roll being arranged on both sides of the wire, whereby the belt is uncoiled from the roll and coiled onto the roll according to the reciprocating motion of the measuring head. Thus, there is no belt or any other element supporting the paper web at the measuring windows, but inside a measuring beam in the lateral direction of the carriage, the paper web is supported during the whole of the measurement. Moreover, the WO publication discloses a solution for supporting a paper web after it has detached from the

wire or felt before the measuring beam and after the measuring beam before the wire. The publication suggests the use of air blow pipes extending over the whole width of the web and plane-like members attached to them, which form a plane-like surface supporting the web. Flutter of the paper web can be decreased and the speed of the paper web increased by means of these solutions, since no open draws are required for the measurements. However, the solution is mechanically rather demanding to implement. Further, the solution cannot be used in measurements in which the measuring device requires a view over the whole width of the paper web.

An object of the present invention is to provide an arrangement according to which properties of a paper web can be measured in such a way that the web is supported during the measurement in such a way that the supporting member does not considerably disturb the measurement or considerably affect the measurement results.

An arrangement according to the invention is characterized in that the supporting member is a plane-like support surface, which extends substantially over the whole width of the paper web in the cross-direction relative to the direction of travel of the paper web and on which an opening arrangement formed by at least one opening is arranged for measuring properties of the paper web.

The essential idea of the invention is that the arrangement comprises a measuring device, which is arranged in connection with the supporting member, i.e. the plane-like support surface. The plane-like support surface is substantially unmoving and has an opening arrangement covering substantially the whole width of the paper web. The idea of a preferred embodiment is that the support surface is arranged at least partly curved in such a way that the air brought along by the paper web forms an air layer between the plane-like support surface and the paper web. The idea of another preferred embodiment is that the opening arrangement is covered by transparent material.

An advantage of the invention is that the paper web can be supported in a simple and mechanically reliable way from the moment when the web detaches from the wire or felt, through the measuring beam and past the measuring sensors, until the web is again supported by the wire on the other side of the measuring beam. By means of the plane-like support surface, flutter of the paper web can be significantly decreased or even totally eliminated, whereby the structures required for measurement of paper properties do not

impose any restrictions on the speed of the paper machine. When an air layer is formed between the support surface and the paper web, the plane-like support surface only subjects the paper web to the friction caused by air resistance. Thus, the support surface does not leave scratches or other traces on the paper web. By covering the openings with transparent material the measurements can be implemented through the openings, but the surface of the support surface is made very smooth.

In connection with this description, the term 'paper' also refers to paper board and tissue in addition to paper.

The invention is explained in greater detail in the attached drawings, of which

Figure 1 schematically illustrates a side view of a cross-section of an arrangement according to the invention;

Figure 2 illustrates a perspective view of a plane-like support surface according to the invention; and

Figure 3 schematically illustrates a top view of another plane-like support surface used in connection with the arrangement of the invention.

Figure 1 illustrates an arrangement according to the invention seen from one side. In a paper machine, a paper web 1 is typically supported mainly by means of supporting wires 2, for example. The paper web 1 moves during the manufacture of paper in the direction of arrow A. The wire rotation of the supporting wires 2 is implemented by means of wire guide rolls 3. The paper web 1 is taken onto a plane-like or planar support surface 4 upon the supporting wire 2, being further led from the support surface 4 to the next supporting wire 2. The supporting wires 2 and the plane-like support surface 4 are arranged substantially in contact with each other, in other words in such a way that the paper web 1 is supported substantially all the time by means of either the supporting wire 2 or the support surface 4, i.e. there is no gap between the supporting wires 2 and the support surface 4, or the gap is so small that it does not considerably obstruct the travel of the paper web. The support surface 4 is arranged to extend substantially over the whole width of the paper web 1 in the cross-direction relative to the direction of travel A of the paper web. The plane-like support surface 4 is at least partly curved in such a way that the air brought along by the paper web 1 forms an air layer between the paper web 1 and the support surface 4 in such a way that the paper web 1 is substantially not in contact with the support surface 4. The support surface 4

has a smooth surface, whereby the formed air layer keeps the paper web 1 throughout at an equal distance from the surface of the support surface 4.

Openings 5 are arranged on the support surface 4, extending substantially from one edge of the paper web 1 to the other edge in the cross-direction relative to the direction of travel A of the paper web 1. The arrangement further comprises measuring sensors provided with a measuring transmitter 6 on the first side of the paper web 1 and a measuring receiver 7 at the corresponding point on the second side of the paper web 1, for the purpose of transmission measurement, for example. The measuring transmitter 6 and the measuring receiver 7 may be arranged in a measuring carriage 8. The measuring carriage 8, in turn, is arranged in relation to a measuring beam 9 to traverse back and forth in the cross-direction relative to the direction of travel of the paper web in a manner known *per se*. Owing to the openings 5, the measurement can be implemented through the support surface 4 in such a way that the support surface does not affect the measurement results. There may be several successive openings 5 on the support surface 4 in the direction of travel A of the paper, whereby measuring sensors measuring a single property or different properties may be positioned in connection with different openings 5. On the other hand, also in connection with one opening 5, several different sensors may be moved successively in the cross-direction of the paper, which allows measurement of different properties of the web, or, if desired, measurement of a single property through one opening 5. Properties measured from the paper may include moisture content, basis weight, paper thickness, etc.

Further, one or more measuring holes 10 may be arranged on the support surface 4. Properties of the paper web 1 can be measured at the measuring holes 10 as point measurement by means of measuring sensors remaining substantially unmoving. The temperature in the vicinity of the paper web 1, for example, can be measured through the measuring hole 10. Pressure-measuring holes 11 may also be arranged on the support surface 4, in connection with which holes pressure-measuring sensors 12 may be arranged. The pressure-measuring sensors 12 allow measurement of the pressure in the air layer between the paper web 1 and the support surface 4, and thus also definition of the tension profile of the paper web 1.

Air blow holes 13 may also be arranged on the support surface 4. Air can be blown by air blow means 14 through the air blow holes 13 between

the plane-like support surface 4 and the paper web 1. By means of the air blow the tail threading of the paper web 1 can be improved and the formation of an air layer strengthened during the manufacture of paper.

5 A transparent cover 5a may be arranged on the openings 5. The transparent cover 5a enables measurement through the support surface 4 through the openings 5, but at the same time it removes the discontinuity points from the surface of the support surface 4, whereby the paper web 1 travels over the support surface 4 smoothly and without flutter. The transparent cover 5a may be glass or plastic, for instance.

10 Figure 2 illustrates the plane-like support surface 4 as a perspective view. The openings 5 cover substantially the whole width of the paper web, in other words their length may up to 10 meters, for example. The width of the openings 5 is very restricted relative to the length; they may be a few centimetres wide or narrower, for example. At the opening 5, a measuring sensor may
15 be arranged which detects the whole width of the paper web 1 and is able to perform the measurement over the whole width of the paper web in one go.

Figure 3 illustrates a plane-like support surface 4, on which two opening arrangements are formed substantially over the whole width of the support surface 4 in the cross-direction relative to the direction of travel A of the paper web 1. In the embodiment shown in Figure 3, however, one opening
20 5 does not extend from one edge of the paper web to the other, but there are necks 15 between the openings. Owing to the necks 15, a firm structure is achieved for the support surface 4. Naturally, properties of the paper web 1 cannot be measured at the point of the necks 15, at least not by means of transmission measurement. However, the necks 15 may be made so narrow
25 that breaks in the measurements of the length of the necks 15 are so short that they do not considerably impair the measurement results and that a break in the measurement profile at the point of the necks 15 does not cause problems. The next openings 5 relative to the direction of travel A of the paper web
30 1 can, however, be arranged to stagger with the preceding openings 5 in such a way that at least at the preceding necks 15 there is an opening, whereby the points that could not be measured at the first necks 15 can be measured from other openings 5.

35 The drawings and the related description are only intended to illustrate the idea of the invention. The details of the invention may vary within the scope of the claims. Thus, the plane-like support surface 4 may be positioned

6

either under or upon the moving paper web 1, depending on the measurement location and the properties to be measured. Further, the plane-like support surface 4 may be used not only in transmission measurement, but also in reflection measurement applications. All in all, the invention is particularly suitable for very fast paper machines that can produce even more than 2,200 meters of paper per minute.

CLAIMS

1. An arrangement for measuring properties of a moving paper web, which arrangement comprises measuring means for measuring properties of a paper web (1) and a supporting member for supporting the paper web (1) in connection with the measuring means, **characterized** in that the supporting member is a plane-like support surface (4), which extends substantially over the whole width of the paper web (1) in the cross-direction relative to the direction of travel (A) of the paper web, and on which an opening arrangement formed by at least one opening (5) is arranged for measuring properties of the paper web.
2. An arrangement according to claim 1, **characterized** in that the opening arrangement is arranged to extend substantially over the whole width of the paper web (1) in the cross-direction relative to the direction of travel (A) of the paper web (1).
3. An arrangement according to claim 2, **characterized** in that at least one opening (5) extends substantially over the whole width of the paper web (1).
4. An arrangement according to any one of the preceding claims, **characterized** in that the opening (5) has a transparent cover (5a).
5. An arrangement according to any one of the preceding claims, **characterized** in that the support surface (4) is arranged in such a way that the paper web (1) is substantially not in contact with the support surface (4).
6. An arrangement according to claim 5, **characterized** in that the plane-like support surface (4) is at least partly curved in such a way that the air brought along by the paper web (1) forms an air layer between the paper web (1) and the plane-like support surface (4).
7. An arrangement according to claim 6, **characterized** in that the plane-like support surface (4) is provided with pressure-measuring holes (11), and that the arrangement comprises means (12) for measuring the pressure in the air layer for the purpose of defining the tension of the paper web (1).
8. An arrangement according to any one of the preceding claims, **characterized** in that in connection with the plane-like support surface

(4), air blow means (14) are arranged for blowing air between the plane-like support surface (4) and the paper web (1).

5 9. An arrangement according to any one of the preceding claims, **characterized** in that the plane-like support surface (4) is provided with at least one measuring hole (10) for single measurements.

10 10. An arrangement according to claim 9, **characterized** in that in connection with the measuring hole (10), means are arranged for measuring the temperature of the paper web (1) in the vicinity of the paper web.

11. An arrangement according to any one of the preceding claims, **characterized** in that the measuring means comprise at least one measuring transmitter (6) and at least one measuring receiver (7).

15 12. An arrangement according to any one of the preceding claims, **characterized** in that the measuring means are arranged to measure properties of the paper web (1) through the plane-like support surface (4) through the openings (5).

13. An arrangement according to claim 12, **characterized** in that the measuring means are arranged to measure properties of the paper web (1) by means of transmission measurement.

20 14. An arrangement according to any one of the preceding claims, **characterized** in that at least one measuring means is arranged to be moved back and forth in the cross-direction relative to the direction of travel of the paper web (1).

25 15. An arrangement according to any one of the preceding claims, **characterized** in that the plane-like support surface (4) is provided with at least two openings (5) successively in the direction of travel of the paper web (1).

16. An arrangement according to claim 15, **characterized** in that in connection with each opening (5), measuring means are arranged.

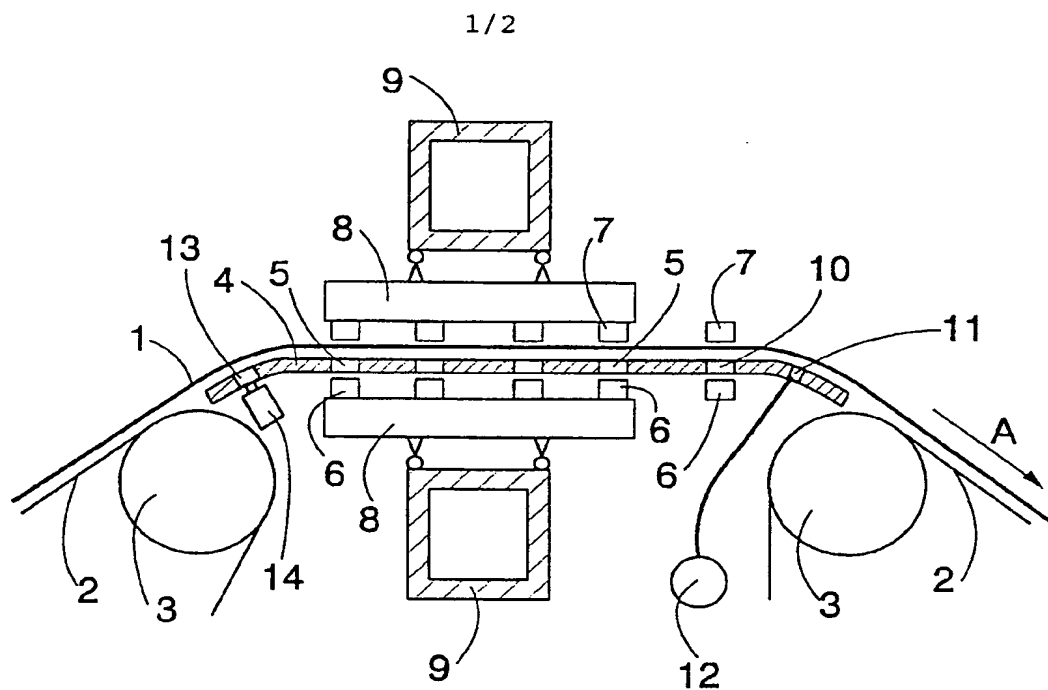


FIG. 1

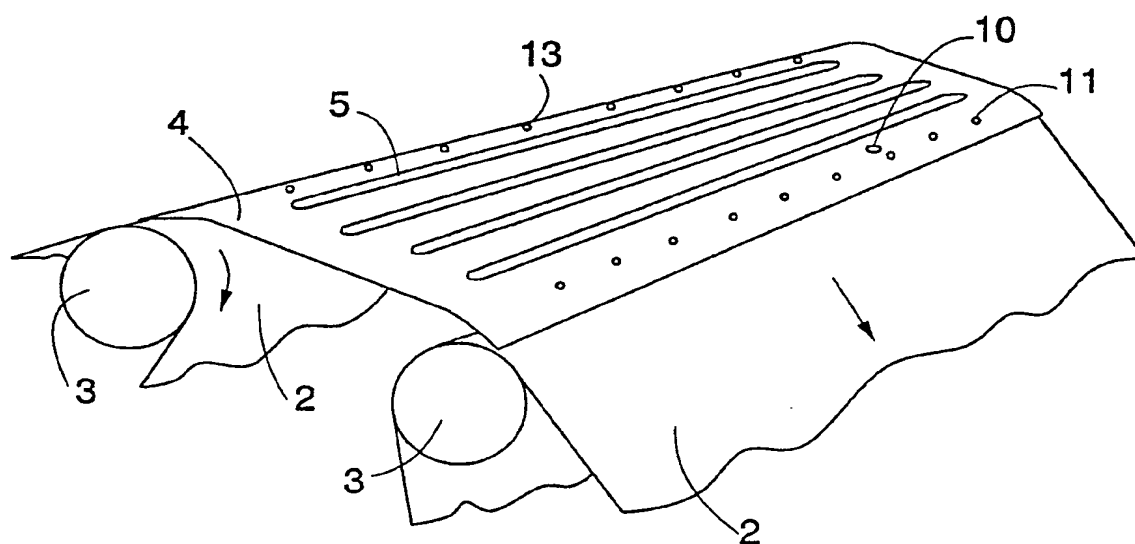


FIG. 2

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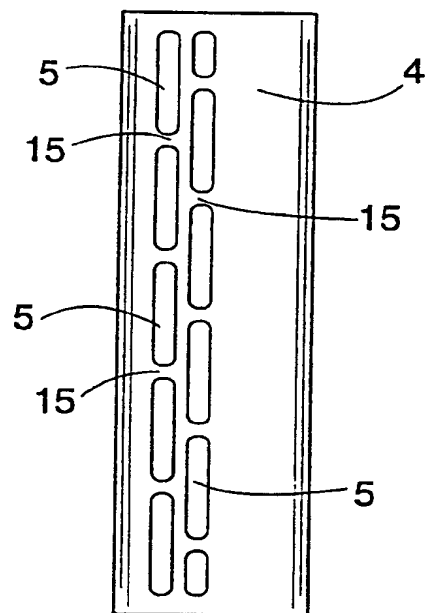


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00650

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G01N 21/89, D21F 7/00, G01B 21/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G01B, G01L, G01N, D21F, D21G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3732430 A (F.HUJER ET AL), 8 May 1973 (08.05.73), figures 1-3, abstract --	1
A	US 4783647 A (D.F.WOOD), 8 November 1988 (08.11.88), figure 2, abstract --	1-16
A	US 3855524 A (J.H.CRAWFORD), 17 December 1974 (17.12.74), figure 1, abstract --	1-16
A	US 3868851 A (EBERHARD BEYER), 4 March 1975 (04.03.75), abstract --	1-16

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

7 November 2000

Date of mailing of the international search report

16 -11- 2000

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00650

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5642192 A (D.A.GORDON ET AL), 24 June 1997 (24.06.97), figure 7, abstract --	1-16
A	US 4194840 A (J.M.LUCAS ET AL), 25 March 1980 (25.03.80), abstract --	1-16
A	US 3992100 A (F.P.LODZINSKI ET AL), 16 November 1976 (16.11.76), figure 3, abstract -- -----	1-16

INTERNATIONAL SEARCH REPORT
Information on patent family members

03/10/00

International application No.
PCT/FI 00/00650

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